**Decision Rationale**

**Total Maximum Daily Load for**
**Fecal Coliform for Gills Creek**

## I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDL for fecal coliform for Gills Creek. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDL is designed to implement applicable water quality standards.
2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDL considers the impacts of background pollutant contributions.
4) The TMDL considers critical environmental conditions.
5) The TMDL considers seasonal environmental variations.
6) The TMDL includes a margin of safety.
7) There is reasonable assurance that the TMDL can be met.
8) The TMDL has been subject to public participation.

## II. Background

The 27,417 acre Gills Creek watershed is located in Franklin County. The TMDL addresses a 27.97 mile stream stretch, beginning 1.5 miles west of the Route 684 bridge and extending to Gills Creek's confluence with the Blackwater River. Forest and agricultural lands make up roughly 88% of the 27,000 acre watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 27.97 miles of Gills Creek as being impaired by elevated levels of fecal coliform on Virginia's 1996 Section 303(d) list. The water stayed on the 1998 Section 303(d) list as well. Gills Creek was listed for violations of Virginia's fecal coliform bacteria water quality standard. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth plans on adopting the e-coli and enterococci standards in 2002.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the fecal coliform standard. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the affected streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In the first phase of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated as primary contact for infrequent bathing. The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model or the Margin of Safety (MOS). In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

Gills Creek identified as watershed VAW-L11R, was given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Gills Creek, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, wildlife in-stream, and straight pipes.

Table 1 - Summarizes the Specific Elements of the TMDL.

| Segment | Parameter | TMDL | WLA (cfu/yr) | LA (cfu/yr) | MOS (cfu/yr)* |
|---|---|---|---|---|---|
| Total | Fecal Coliform | 1.99E+14 | 1.10E+10 | 1.99E+14 | 6.48E+12 |

*Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

EPA believes it is important to recognize the conceptual difference among the waste load allocation (WLA) values, load allocation (LA) values for sources modeled as direct deposition to stream segments, and LA values for flux sources of fecal coliform to land use categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segments. The LA in Table 1 is the amount of colony forming units (cfu) reaching the stream from nonpoint sources annually.

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[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

## III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for Gills Creek. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

*1) The TMDL is designed to meet the applicable water quality standards.*

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality standards and designated uses on Gills Creek. The water quality criterion for fecal coliform is a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples are measured against the instantaneous standard. Thirty-eight percent of the samples collected from Gills Creek were in violation of the instantaneous standard of 1,000 cfu/100 mL. However, the TMDL is being modeled to attain the geometric mean of 200 cfu/100 mL. A large portion of the samples collected from Gills Creek were in excess of 200 cfu/100 mL.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Gills Creek will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc.. The model then combines all the data to determine the hydrology and water quality of the stream.

A regression analysis was used to develop the hydrology calibration for Gills Creek. A regression analysis was used because there was insufficient hydrology data on Gills Creek. In a this approach, the modelers used a mathematical equation to convert the flow of a nearby continuously monitored stream (Blackwater River) to that of Gills Creek.

Equation - Flow Gills Creek = 0.328 *(Flow gage#02056900)^0.949

The gage (United States Geological Survey (USGS) gage #02056900) used for the hydrologic calibration was located within the Blackwater River watershed, Gills Creek is a tributary to this watershed. The equation was used to transform the monitored flow at USGS gage #02056900 to flow for Gills Creek. The transformed flow was treated as an observed flow for the calibration. Calibration is the process of comparing modeled data to observed data and making appropriate adjustments to model parameters to minimize the error observed and simulated events.[3] The model was calibrated to flow data from October 1994 to September 1998. This period was selected as representing the hydrology of the area and including the critical conditions associated with the watershed. Several parameters including the evapotranspiration rate, recession rates to groundwater and interflow, storage capacity within the subsurface and surface zones, slope, and forest cover were adjusted to insure that the calibration closely represented the observed data. The model stimulated the observed conditions well.

In order to insure that the calibration is representing actual conditions properly, the model is transferred to a different time period and run without adjusting the hydrologic parameters. The hydrologic model for Gills Creek was validated against observed data from January 1991 through September 1994. Obviously, the model did not perform as well as it did during the calibration phase, however, the model did meet the boundaries established for the validation.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for Gills Creek.

*2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.*

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest, good pasture, poor pasture, cropland, urban, farmstead, loafing lot, golf course, livestock access, and grass), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, lateral flow, and straight pipes), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

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[3]Maptech, 2002. Fecal Coliform TMDL Development for Catoctin Creek Impairments, Virginia. April 23, 2002.

Virginia has stated that there is one point source, Windy Gap Elementary School Wastewater Treatment Plant (WGESWWTP), in the Gills Creek watershed. The school has not yet been developed, but construction is scheduled to be completed by August of 2004. The school is permitted to discharge their effluent to Gills Creek with a fecal coliform concentration of 200 cfu/100 mL. WGESWWTP has no discharge limit but is designed to process 0.004

million gallons of wastewater per day. Their WLA was determined by multiplying their allowable concentration (200 cfu/100 mL) by their permitted flow (0.004 million gallons per day) by the number of days in a year (365). It should be noted that chlorination requirements will in all likelihood reduce fecal coliform concentrations in the effluent to levels substantially lower than the effluent limit.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - Waste Load Allocations for Gills Creek

| Facility | Permit Number | Existing Load | Allocated Load |
|---|---|---|---|
| WGESWWTP | VA0025518 | 1.10E+10 | 1.10E+10 |

<u>Load Allocations</u>

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the Gills Creek watershed. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicants[4]. HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to Gills Creek from forest, grassland, cropland, good pasture, poor pasture, farmstead, livestock access, loafing lots, golf courses and urban lands. The total land loading of fecal coliform is the result of the application of manure, biosolids, and direct deposition from cattle, other livestock and wildlife (geese, deer, etc.); the deposition of fecal coliform from failed septic systems and fecal coliform production from pets.

In addition, VADEQ recognizes the significance of fecal coliform from cattle in-stream, straight pipes, and wildlife in-stream. These sources are not dependent on a transport mechanism to reach a surface waterbody, and therefore, can impact water quality during low and high flow events. Please note that all of the values in Table 3, other than the direct deposit nonpoint sources (cattle in-stream, wildlife in-stream, lateral flow, and straight pipes), are given in terms of cfu to the land surface. The amount of waste from these sources (forest, grassland, cropland, good pasture, poor pasture, livestock access, loafing lots, golf courses, farmstead, and urban lands) reaching the stream is significantly lower. The cattle in-stream load was transferred to the livestock access load in the allocated loadings in Table 3. This causes an increase in fecal coliform loading to the land use.

Table 3 - LA for Fecal Coliform for Gills Creek

| Source | Existing Load | Allocated Load | Percent Reduction |
|---|---|---|---|
| Good Pasture | 1.37E+15 | 1.37E+15 | 0% |
| Poor Pasture | 1.49E+15 | 1.49E+15 | 0% |
| Cropland | 6.18E+15 | 6.18E+15 | 0% |
| Forest | 6.02E+14 | 6.02E+14 | 0% |
| Urban | 3.24E+14 | 3.24E+14 | 0% |
| Farmstead | 1.18E+13 | 1.18E+13 | 0% |
| Livestock Access | 5.42E+13 | 1.69E+14 | -211% |
| Loafing Lot | 4.48E+14 | 4.48E+14 | 0% |
| Golf Course | 1.14E+12 | 1.14E+12 | 0% |
| Hay/Grass | 1.24E+14 | 1.24E+14 | 0% |
| Wildlife In-stream | 2.12E+13 | 1.06E+12 | 95% |

[4] Supra, footnote 2.

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|---|---|---|---|
| Straight Pipes | 4.72E+11 | 0.0 | 100% |
| Lateral Flow | 1.30E+9 | 1.30E+9 | 0% |
| Cattle In-stream | 1.14E+14 | 0.0 | 100% |

*3) The TMDL considers the impacts of background pollution.*

A background concentration was set by determining the wildlife loading to each land segment.

*4) The TMDL considers critical environmental conditions.*

According to the EPA regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Gills Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[5]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for Gills Creek was represented as a typical hydrologic year. Since the stream was modeled to attain the geometric mean standard and base and low flow events occurred far more often (93% of the time) then wet weather events, it was essential that the standard be maintained during these periods. Therefore, base flow conditions were the more critical period. If the standard is attained during dry weather conditions, the geometric mean standard will be insulated against the variability associated with wet weather loading. This caused the allocation scenarios to concentrate on the loadings associated with baseflow conditions.

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[5]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

*5) The TMDLs consider seasonal environmental variations.*

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

*6) The TMDLs include a margin of safety.*

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

Virginia includes an explicit MOS by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% MOS. Since the TMDL was modeled to attain a geometric mean of 190 cfu/ 100mL, the direct deposit loadings were forced to be reduced even more.

*7) There is a reasonable assurance that the TMDL can be met.*

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings.

*8) The TMDLs have been subject to public participation.*

Two public meetings were held to discuss TMDL development on Gills Creek. Both meetings were public noticed in the *Virginia Register* and opened to a thirty-day comment period. The first meeting was held on December 06, 2001 in Burnt Chimney, VA. Approximately 25 people attended this initial meeting on the TMDL. Approximately 20 people attended the second meeting which was held in Moneta, VA on March 18, 2002.